U.S. Department of Energy
Office of Civilian Radioactive Waste Management

www.ocrwm.doe.gov

DOE/NRC Important to Safety Technical Exchange

Las Vegas, Nevada

May 12, 2004

Attachment 3

Agenda

NRC/DOE Technical Exchange on Yucca Mountain
Methodology for Categorizing Systems, Structures, and Components as Important to Safety
May 12, 2004
8:30 a.m. - 4:15 p.m. (PT)
11:30 a.m. - 7:15 p.m. (ET)

Bechtel SAIC Company, LLC
Conference Room 915
9960 Covington Cross
Las Vegas, Nevada

And via videoconferencing to:

U. S. NRC
T-8A1
11545 Rockville Pike
Rockville, MD

CNWRA
Building A103
6220 Culebra Road
San Antonio, TX

INTERESTED PARTIES MAY PARTICIPATE IN THE MEETING VIA TELECON BY CALLING
1-800-638-8081- Passcode 4726# or 301-231-5539 - Passcode 4726#

	Topics	Discussion Lead	Time
I.	**Opening Remarks and Introductions**	Fred Brown , NRC Joseph Ziegler, DOE Tim Kobetz, NRC Joe Price, DOE	8:30-8:45 a.m.
II.	**Methodology for Categorizing Systems, Structures, and Components (SSCs) as Important to Safety:** DOE will discuss it methodology for categorizing SSCs important to safety for Category 1 and 2 event sequences.	Steve Cereghino	8:45-10:00 a.m.
	BREAK		**10:00-10:15 a.m.**
III.	**Examples of Categorization of SSCs Important to Safety:** DOE will provide examples how it intends to document in the license application SSCs that are both important to safety and not important to safety.	Steve Cereghino	10:15-11:30 a.m.
	LUNCH		**11:30-12.45 p.m.**
III.	**Examples of Categorization of SSCs Important to Safety:** Discussion continued	Steve Cereghino	12:45-1:45 p.m.
IV.	**Documenting the selection of SSCs Important to Safety:** Discuss how SSCs important to safety, and in some cases SSC s that are not important to safety, will be documented in the License Application.	Steve Cereghino	1:45-3:00p.m.
	BREAK		**3:00-3:15 p.m.**
VI.	**Caucus: DOE and NRC caucus separately.**		3:15-4:00 p.m.
VII.	**Summary Discussion: Summarize status of the day's discussions and identify open items.**	Tim Kobetz, NRC Joe Price, DOE	4:00-4:15 p.m.
VIII.	**Adjourn**		4:15 p.m.

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Safety Classification of Repository Structures, Systems, and Components

Presented to:
DOE/NRC Important to Safety Technical Exchange

Presented by:
Richard L. Craun
Paul G. Harrington
U.S. Department of Energy

Stephen J. Cereghino
Bechtel SAIC Company, LLC

May 12, 2004
Las Vegas, Nevada

"Important to Safety" and Normal Operations

- **Purpose**
  - To establish mutual understanding of the Project's implementation of the NRC's regulations regarding the identification of repository structures, systems, and components (SSCs) that are "important to safety" (ITS)
- **Objectives**
  - Describe the Project's approach regarding the relationship between SSCs ITS and normal operations
  - Discuss the radiation dose limits that will be applicable for the preclosure safety analyses
  - Discuss the definitions of pertinent terms
  - Discuss examples of SSCs and their safety classification

"Important to Safety" and Normal Operations
(Continued)

- Yucca Mountain Project (YMP) approach
  - SSCs are ITS if function(s) credited to prevent or mitigate Category 1 and/or Category 2 event sequences in demonstration of compliance with 63.111(b)(1) and/or 63.111(b)(2)
  - SSCs that are only required to function to demonstrate compliance with 10 CFR 63.111(a)(1) during normal operations are not ITS. They are required for the facility to conduct or continue nuclear operations
  - SSCs that are not ITS are not subject to Quality Assurance Requirements and Description (QARD) requirements
  - Not every element or appurtenance of an SSC is ITS
- Examples are not all inclusive, work-in-progress

"Important to Safety" and Normal Operations
(Continued)

- **Definitions from 10 CFR 63.2**
  - *Event sequence - a series of actions and/or occurrences within the natural and engineered components of a geological repository operations area (GROA) that could potentially lead to exposure of individuals to radiation. An event sequence includes one or more initiating events and associated combinations of repository system component failures, including those produced by the action or inaction of operating personnel*
  - Category 1 - those event sequences that are expected to occur 1 or more times before permanent closure of the GROA
  - Category 2 - those event sequences that have at least 1 chance in 10,000 of occurring before permanent closure

"Important to Safety" and Normal Operations
(Continued)

- **Definitions from 10 CFR 63.2** (continued)
  - *<u>Important to safety</u> - with reference to SSCs, means those engineered features of the GROA whose function is:*
    - *To provide reasonable assurance that high-level waste (HLW) can be received, handled, packaged, stored, emplaced, and retrieved without exceeding the requirements of 10 CFR 63.111(b)(1) for Category 1 event sequences*
    - *To prevent or mitigate Category 2 event sequences that could result in radiological exposures exceeding the values specified at 10 CFR 63.111(b)(2) to any individual located on or beyond any point on the boundary of the site*

"Important to Safety" and Normal Operations
(Continued)

- **Repository conditions**
  - Normal operations
    - Operation of SSCs in the designed configuration for handling and emplacing spent nuclear fuel (SNF) or HLW that will not lead to unplanned worker or public dose
  - Event sequences include failures of SSCs and are considered off-normal occurrences or accidents and are distinct from normal operation
  - Fuel assembly drop
    - Anticipated event sequence
    - Category 1 event sequence due to SSC reliabilities and expected throughput
    - Not considered normal operations

"Important to Safety" and Normal Operations
(Continued)

- **Repository conditions** (Continued)
  - Stable conditions
    - The state following a Category 1 or Category 2 event sequence when design features and/or operator actions have terminated the unplanned release of radioactive materials
  - Recovery
    - Remediation, restoration or other activities following the termination of a Category 1 or Category 2 event sequence that are necessary to return the repository to normal operation

Preclosure Radiation Dose Limits

Normal Operations and Category 1 Event Sequences

Person Type	Annual Dose Limit	Regulation
All	ALARA	10 CFR 20.1101(b)
Restricted Area Worker	Occupational Dose 5 Rem	10 CFR 63.111(a)(1) 10 CFR 63.111(b)(1) 10 CFR 20.1201
Controlled Area Worker and Member of Public on Site	10CFR20 Public Dose 100 mrem, and 2 mrem in any hour and for ALARA 10 mrem from air emissions to the environment	10 CFR 63.111(a)(1) 10 CFR 63.111(b)(1) 10 CFR 20.1301(a)(1) 10 CFR 20.1301(a)(2) 10 CFR 20.1101 (d)
NTS/Nellis Workers (Unrestricted Area)	10CFR20 Public Dose 100 mrem and 2 mrem in any hour and for ALARA 10 mrem from air emissions to the environment	10 CFR 63.204 10 CFR 63.111(a)(1) 10 CFR 63.111(b)(1) 10 CFR 20.1301(a)(1) 10 CFR 20.1301(a)(2) 10 CFR 20.1101 (d)
Real Member of Public Beyond Site Boundary (In General Environment)	15 mrem	10 CFR 63.204 10 CFR 63.111(a)(2) 10 CFR 63.111(b)(1)

Preclosure Radiation Dose Limits

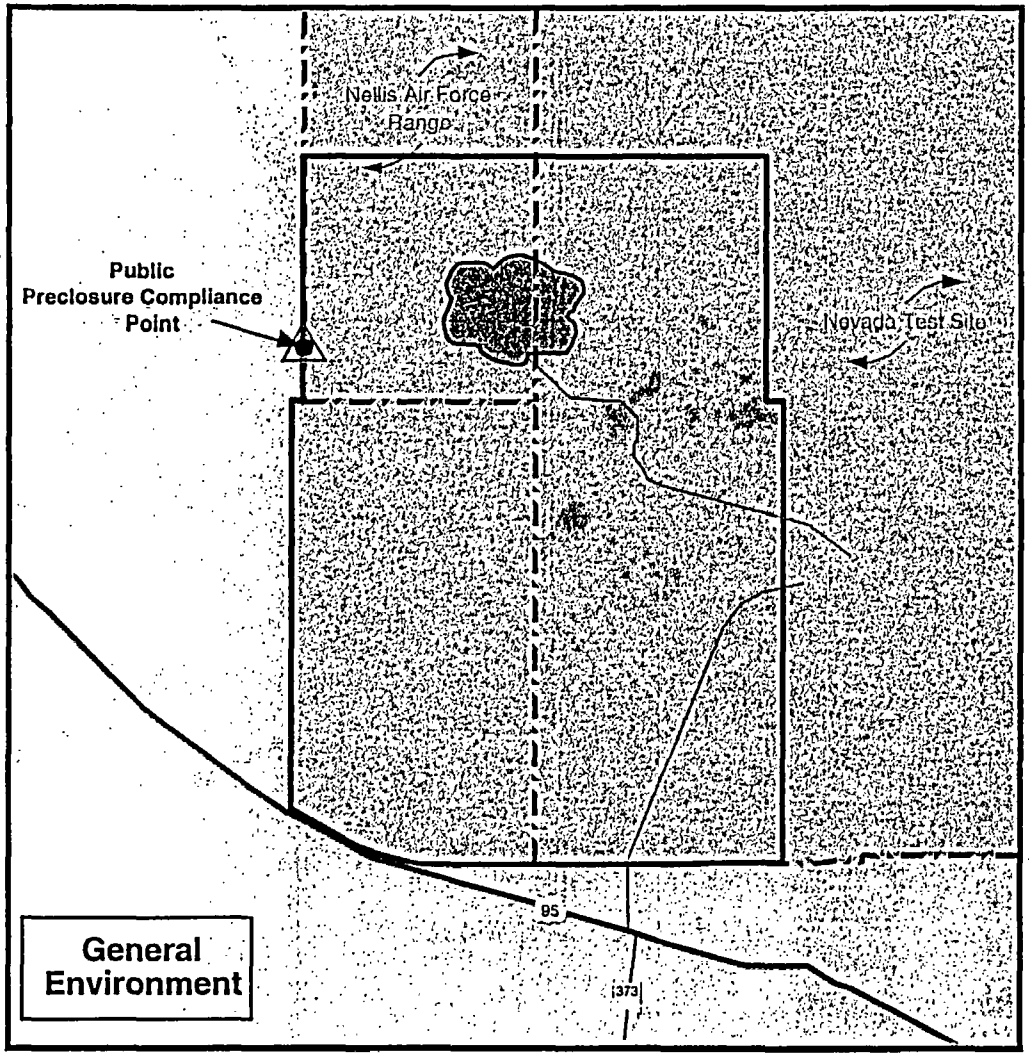
(Continued)

Category 2 Event Sequences

Person Type	Single Category 2 Event Sequence Dose Limit	Regulation
Individual on or Beyond the Site Boundary	5 Rem	10 CFR 63.204 10 CFR 63.111(b)(2)

Preclosure Radiation Dose Limits

(Continued)

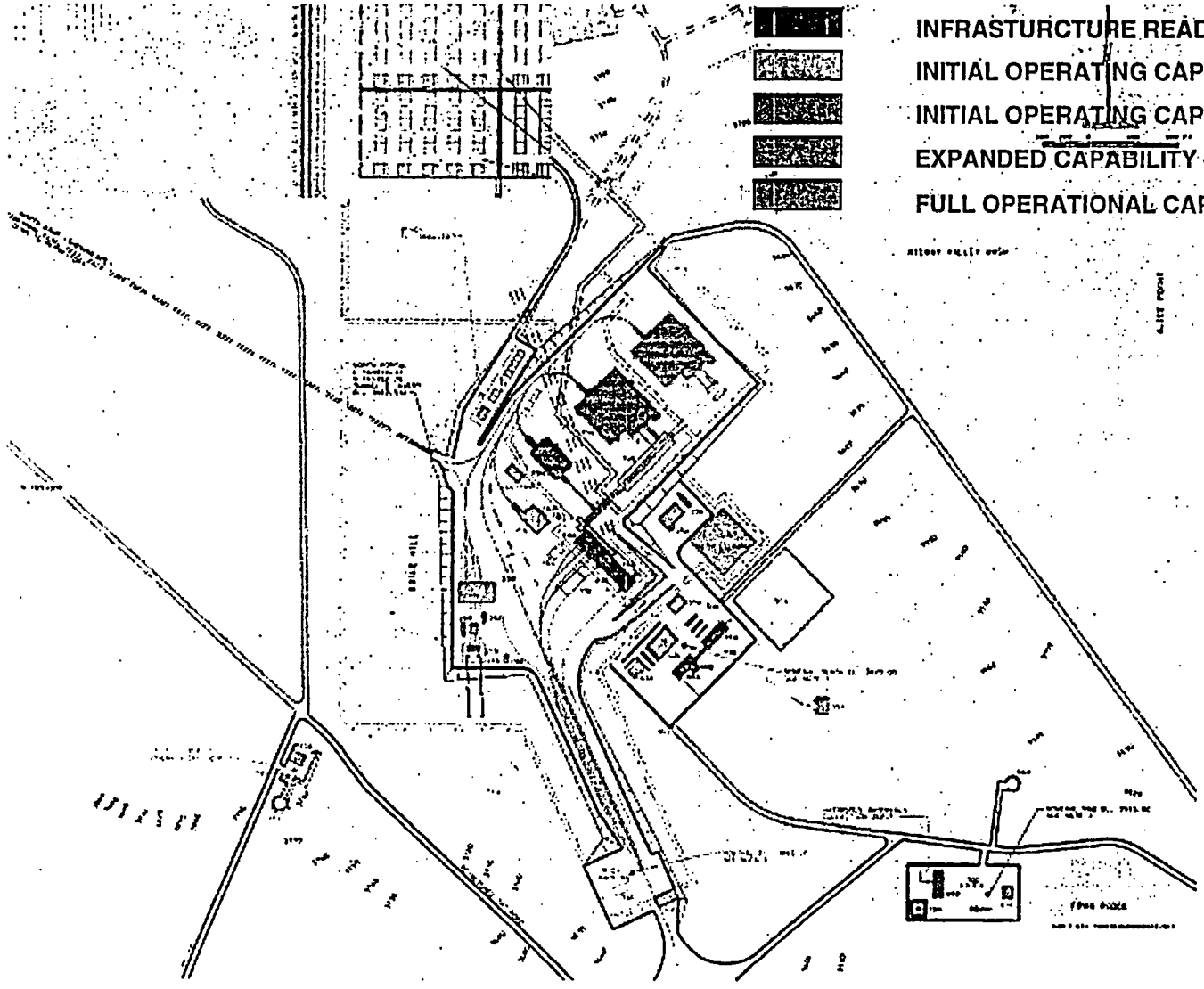


Legend

- Property Boundaries
- GROA (Restricted Area)
  Annual Dose Limit: 5 Rem
- Yucca Mountain Site
  Annual Dose Limit: 100 mrem
- Nellis Air Force Range and Nevada Test Site
  Annual Dose Limit: 100 mrem
- *General Environment*
  Annual Dose Limit: 15 mrem
  Category 2 Event Limit: 5 Rem

Preclosure Compliance Point is defined as the nearest point of the General Environment to the repository footprint

Yucca Mountain Project Site



INFRASTURCTURE READINESS

INITIAL OPERATING CAPACITY FUEL HANDING FACILITY

INITIAL OPERATING CAPACITY CANISTER HANDLING FACILITY

EXPANDED CAPABILITY - DRY TRANSFER FACILITY I

FULL OPERATIONAL CAPABILITY - PHASE II

Examples of Safety Classification of Structures, Systems, and Components

- Radiation Monitor
  - ITS if: function is to provide an alarm for credited operator action or to actuate a design feature for mitigation of Category 1 or Category 2 event sequence doses to less than the Part 20 or Part 63 limits
  - Not ITS if: area radiation monitors only perform a Radiation Protection Program function

Examples of Safety Classification of Structures, Systems, and Components

(Continued)

- **Shield Wall**
  - ITS if: credited for limiting worker radiation dose from a Category 1 event sequence to less than the Part 20 limits
  - Not ITS if: its only function is to limit worker radiation doses during normal operation

Examples of Safety Classification of Structures, Systems, and Components
(Continued)

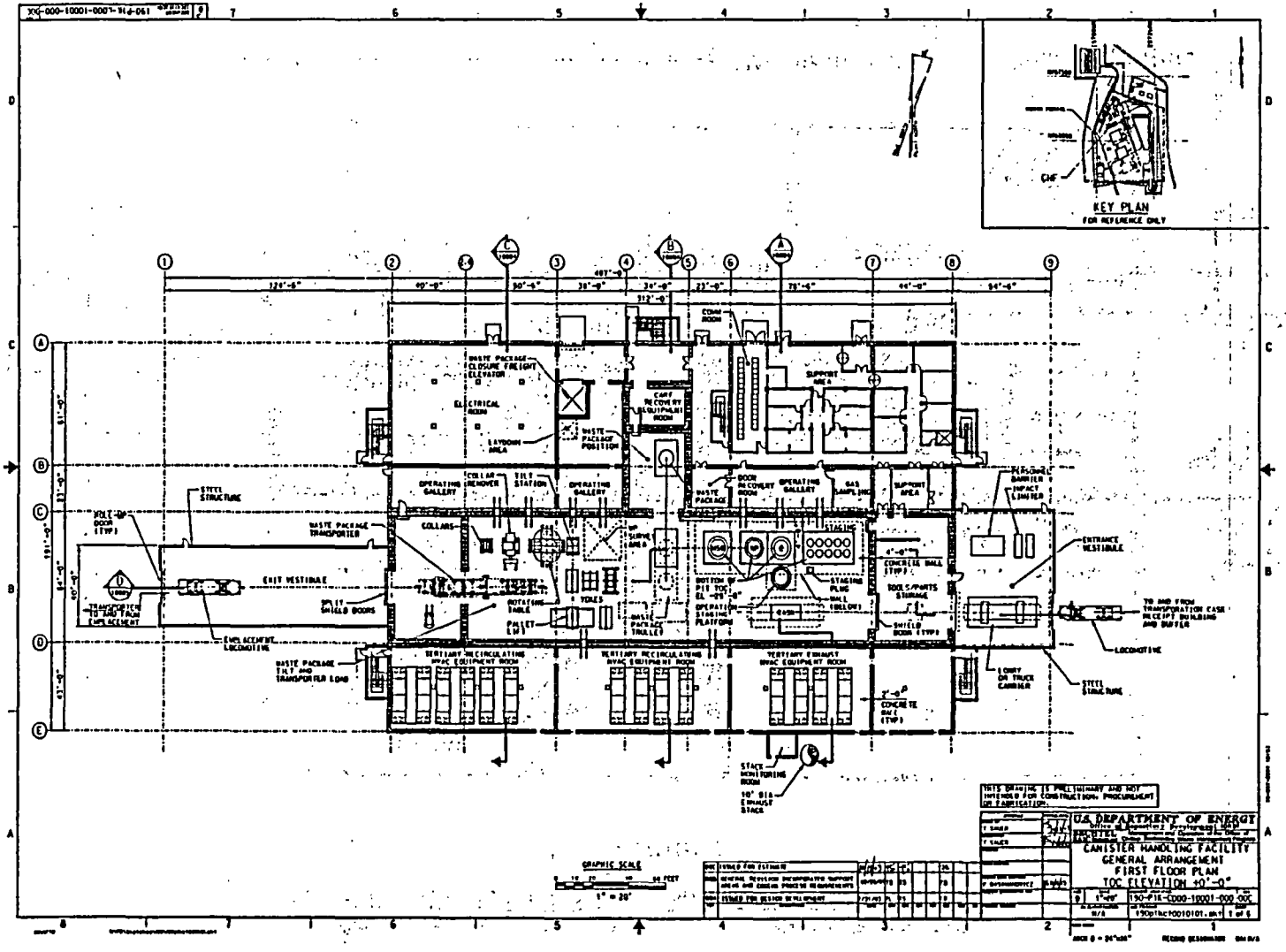
- Radiation Protection Program consumables, personnel dosimetry, radiacs, step-in radiation monitors, and portable lead shielding are not ITS
- Reach rods and manipulators designed to limit worker radiation dose during normal operations are not ITS

Examples of Safety Classification of Structures, Systems, and Components

(Continued)

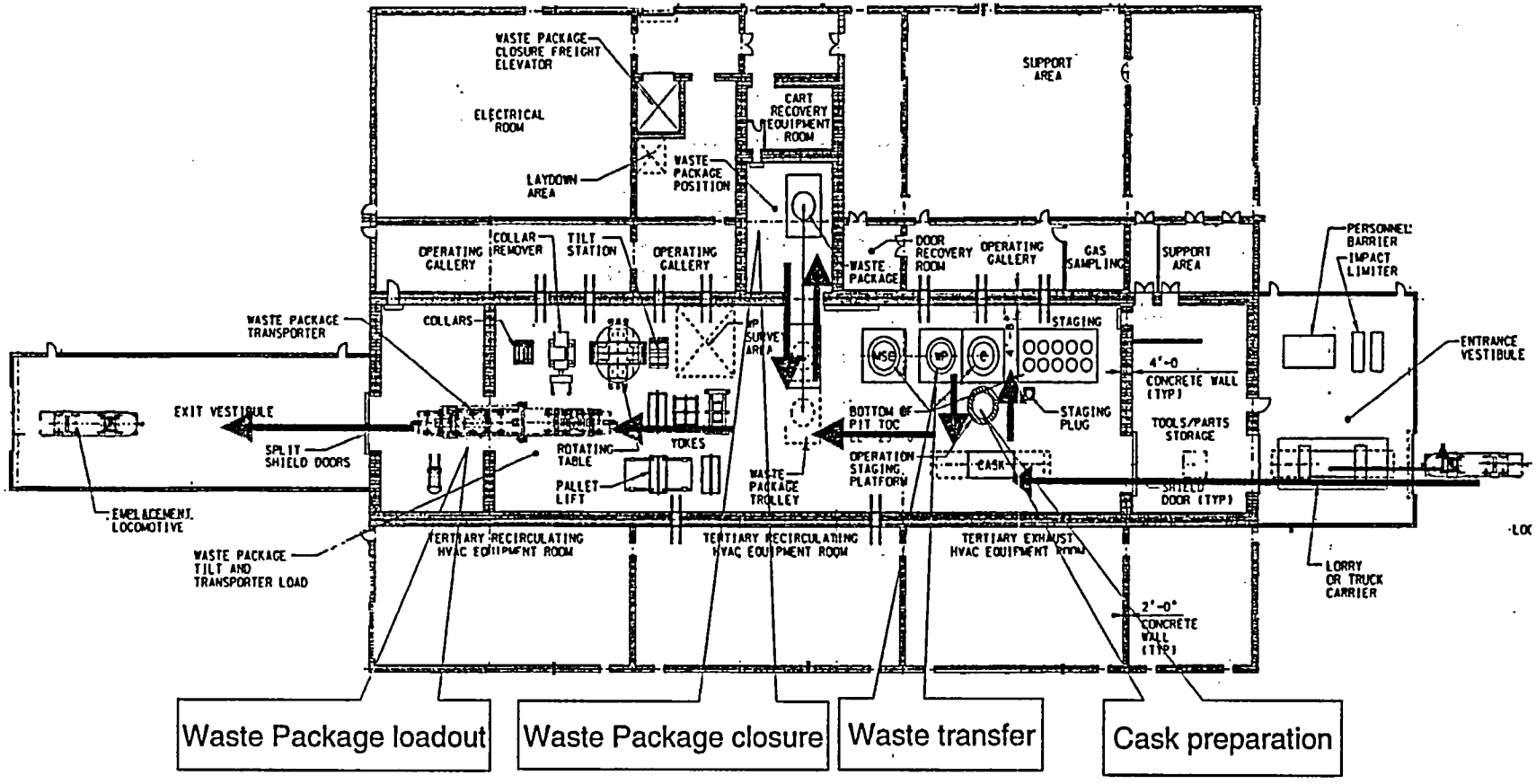
- **Ventilation System**
  - ITS if: ventilation system dampers, fans, filters, ducting, and other required supporting SSCs credited for limiting radiation worker dose from a Category 1 event sequence to less than the Part 20 limits
  - Not ITS if: ventilation system dampers, fans, filters, ducting, and other required supporting SSCs only for limiting radiation worker dose during normal operation

Canister Handling Facility Shielding Example



Canister Handling Facility Shielding Example

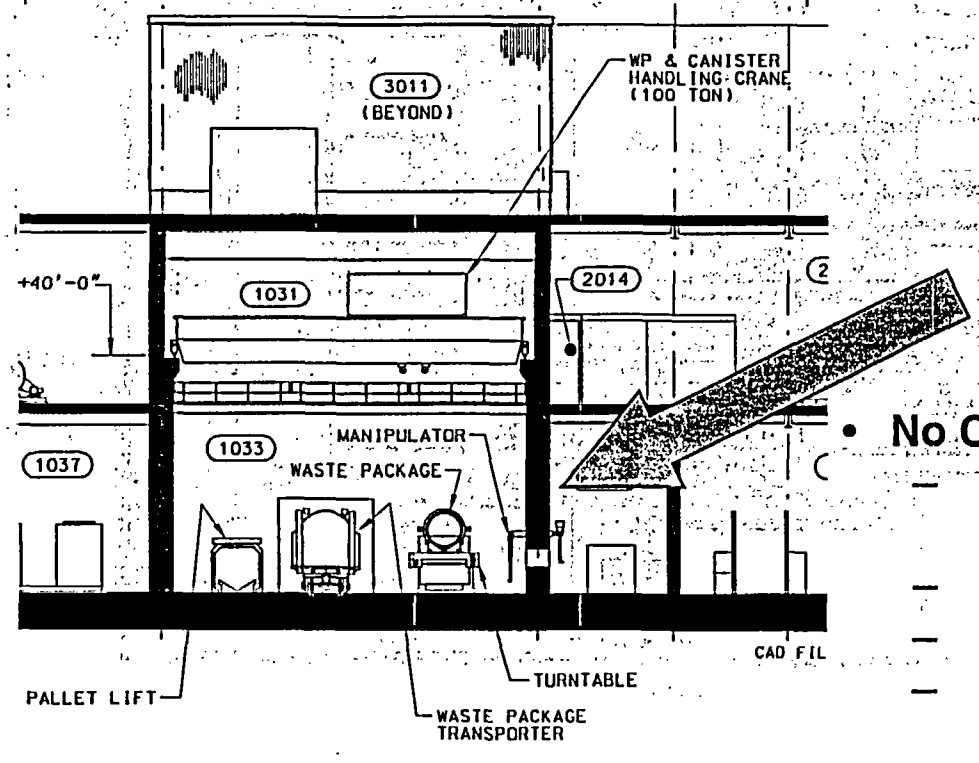
(Continued)



Canister Handling Facility Shielding Example

(Continued)

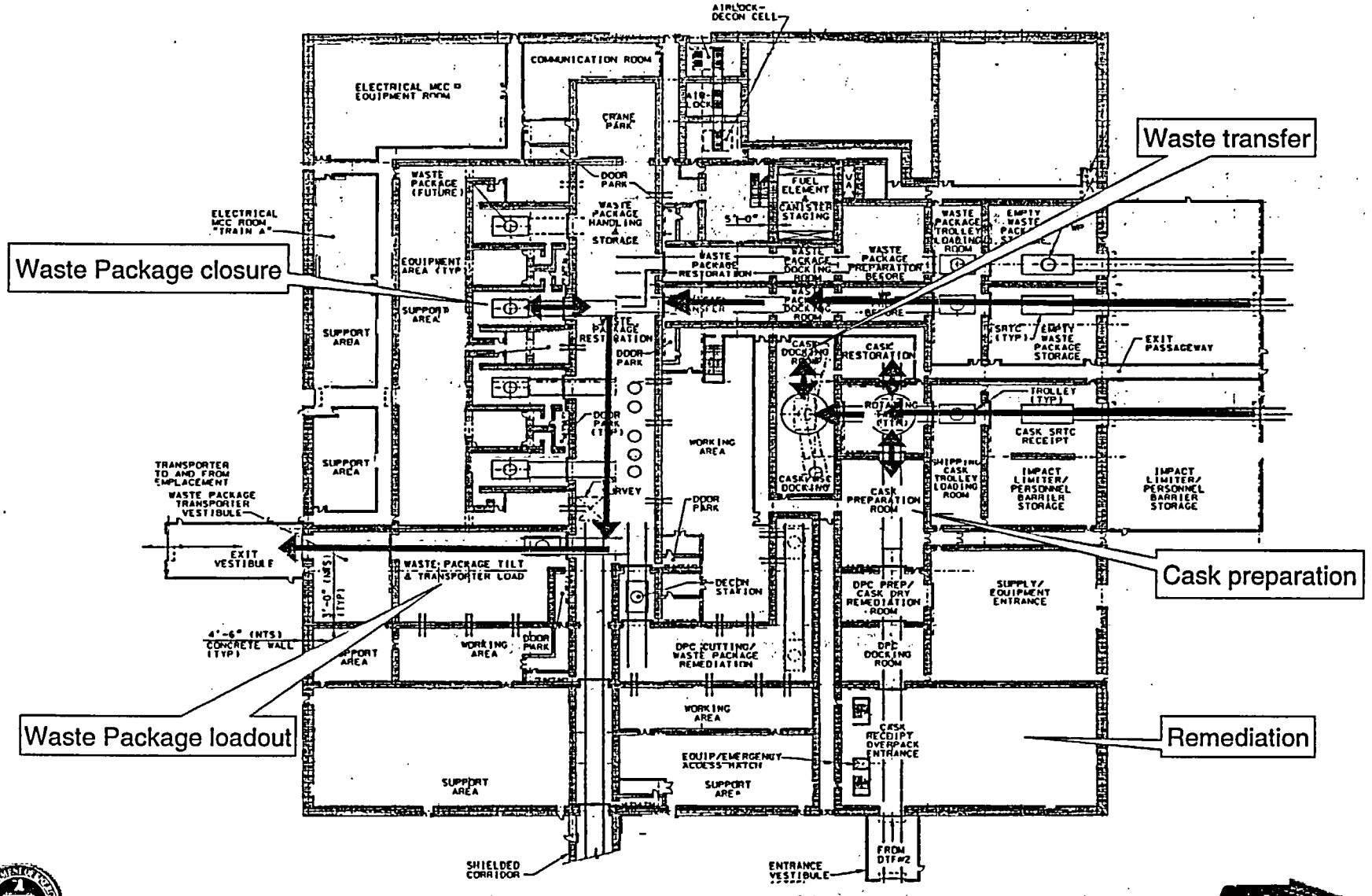
Canister Handling Facility (CHF) - Section Showing Open Transfer Bay (Shield Walls and Manipulator)



Not-ITS Shielding Function

- No Category 1 event sequences
  - No uncanistered SNF or HLW handling
  - Limited lift heights
  - Reliable handling equipment
  - Low number of annual lifts

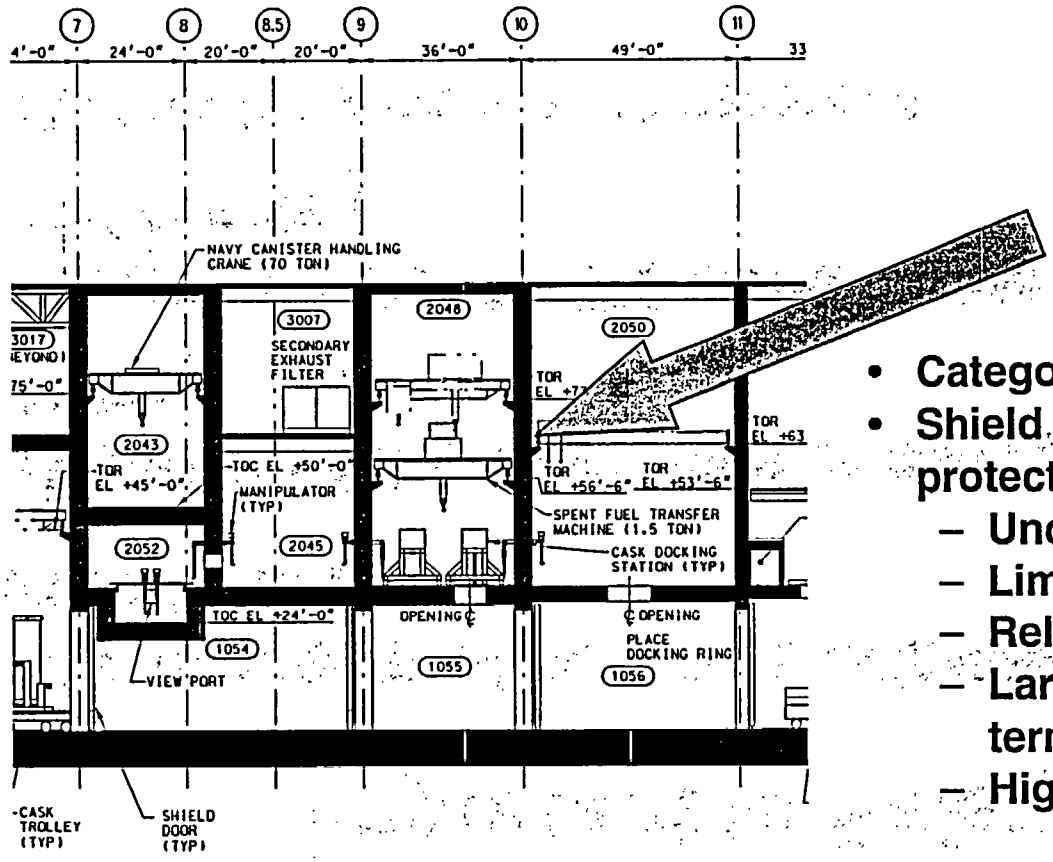
Dry Transfer Facility Shielding Example



Dry Transfer Facility Shielding Example

(Continued)

DTF - Elevation Showing the Dry Transfer Cell (Shield Walls and Manipulators)



ITS Shielding Function

- Category 1 event sequences
- Shield wall credited for worker protection
  - Uncanistered SNF handling
  - Limited lift heights
  - Reliable handling equipment
  - Larger radionuclide source term
  - High number of annual lifts

Non-Shielding Functions of Structures Important to Safety

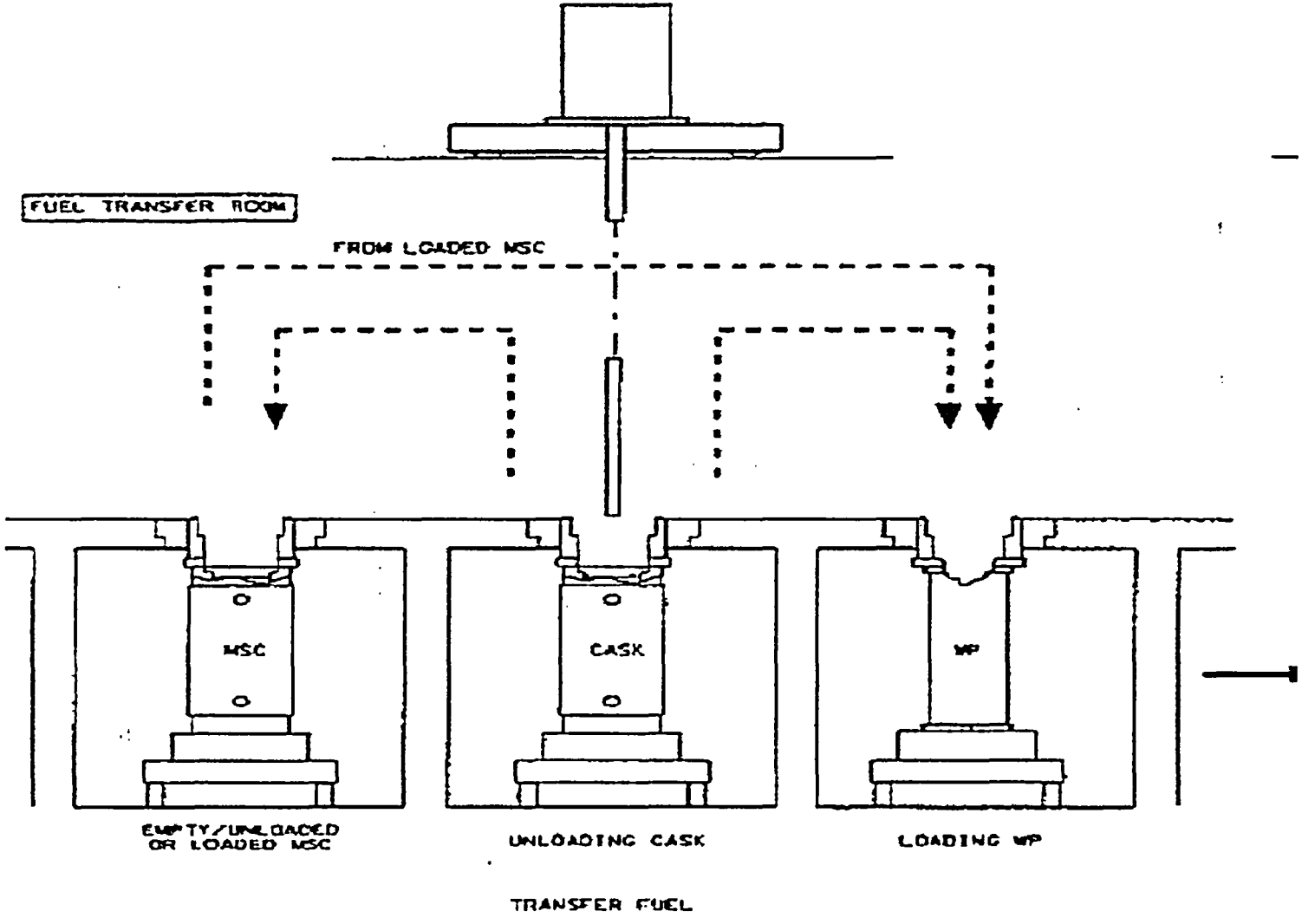
- Safety function of some structures may be other than shielding
  - Ensure no collapse of walls or ceilings onto waste forms
  - Provide support for ITS crane during ITS operations and events
  - Protect from natural phenomena

Event Sequences that Could Occur During Dry Fuel Handling

- Fuel assembly drop into transportation cask
- Drop of canister into transportation cask
- Unsealed waste package drop

(Examples are not all inclusive, work-in-progress)

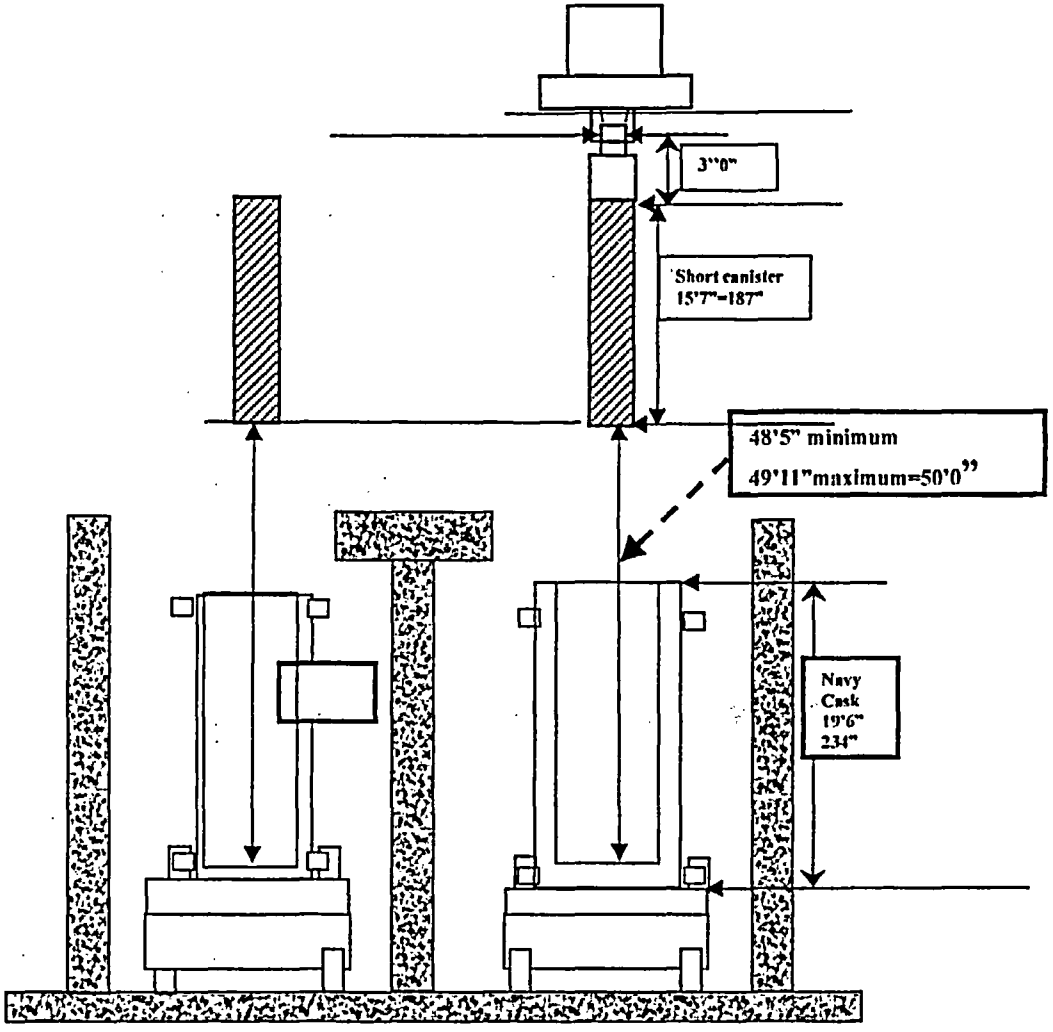
Fuel Assembly Drop into Transportation Cask



Fuel Assembly Drop into Transportation Cask

- 2 assemblies are involved
  - Breached
  - Gap gases and particulates released and dispersed
- SSCs ITS:
  - Fuel assembly transfer machine to limit drop frequency
  - Confinement to limit worker dose
  - Ducting and stack for elevated release to limit dose in the Controlled Area

Drop of Canister into Transportation Cask



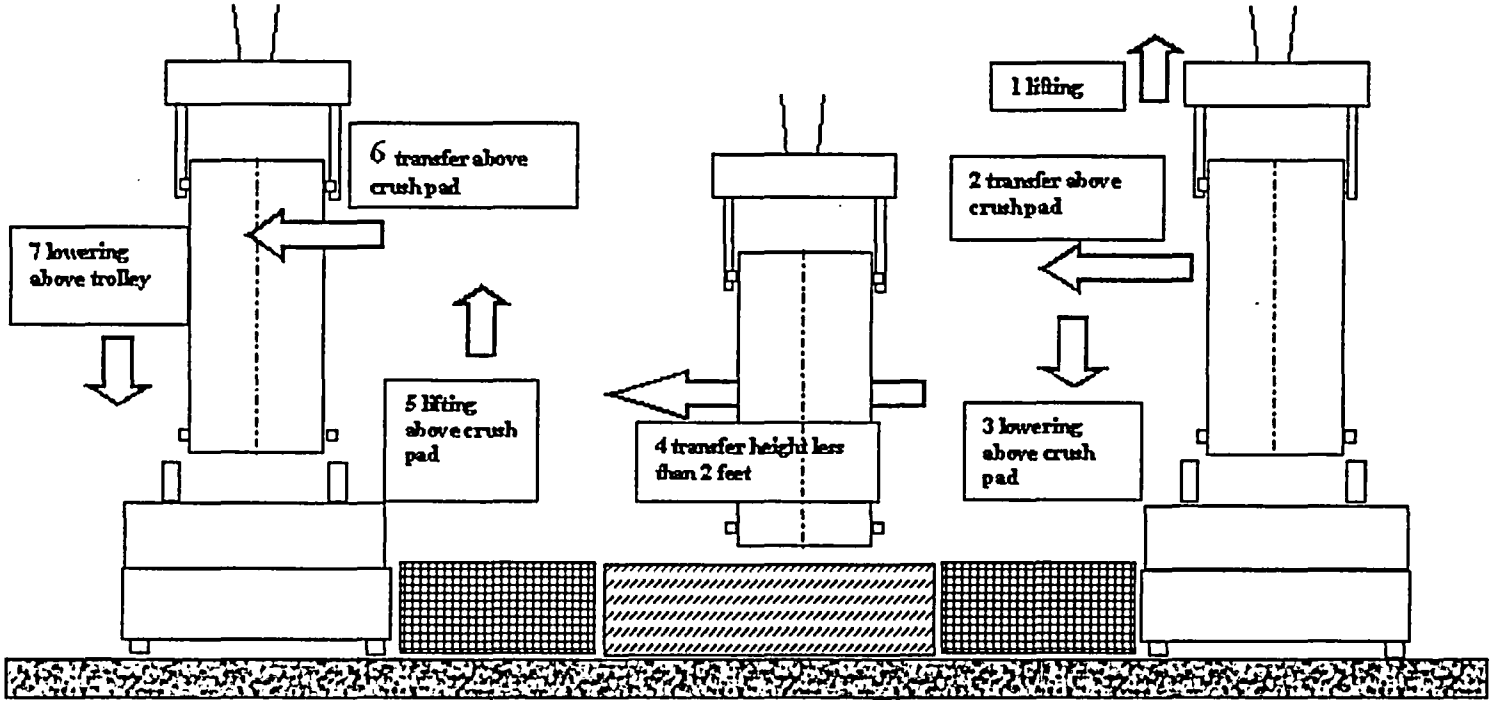
This sketch is for the short canister (length 187 in.)
For the long canister (length 212 in.), drop height is 48'0".

Drop of Canister into Transportation Cask

- Navy or DOE HLW Canisters
  - Breached
  - Gases and particulates released and dispersed
- DOE SNF Canister and Multicanister Overpack
  - Drop and breach Beyond Category 2
- Two SSCs ITS:
  - Crane reliability to minimize drop probability
  - Canister integrity to minimize breach potential
  - Crane design to limit lift heights

Unsealed Waste Package Drop

In DTF, Cell 1044 waste package handling and storage cell



Unsealed Waste Package Drop

(Continued)

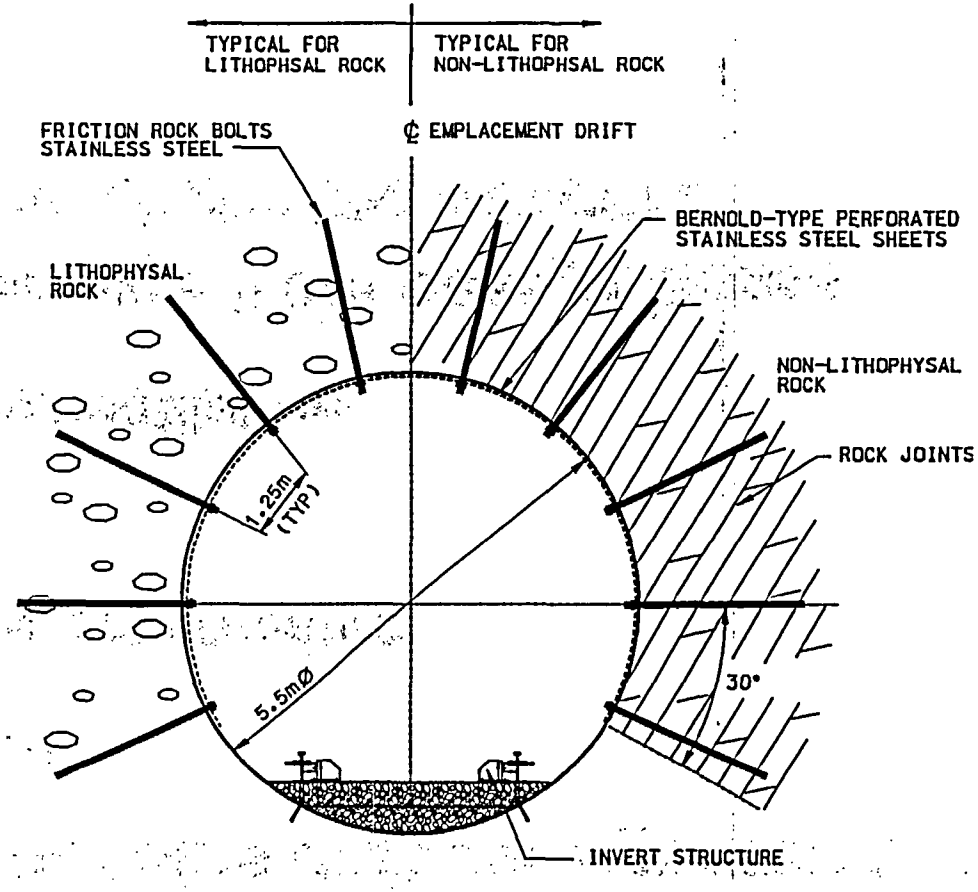
- Drop of one waste package
  - Fuel assemblies in the waste package are breached
  - Gap gases and particulates are released and dispersed
- Contents vary
  - Commercial spent fuel assemblies, PWR or BWR
  - Naval canister
  - DOE standard canister of spent nuclear fuel
  - DOE multicanister overpack
  - DOE Canister of high-level waste

Unsealed Waste Package Drop
(Continued)

- **SSCs ITS:**
  - Waste package crane reliability to minimize drop probability
  - Facility and crane design to limit drop height
  - DOE SNF canister integrity to make breach Beyond Category 2
  - Crush pad to absorb impact energy

Classification of Emplacement Drift Ground Support

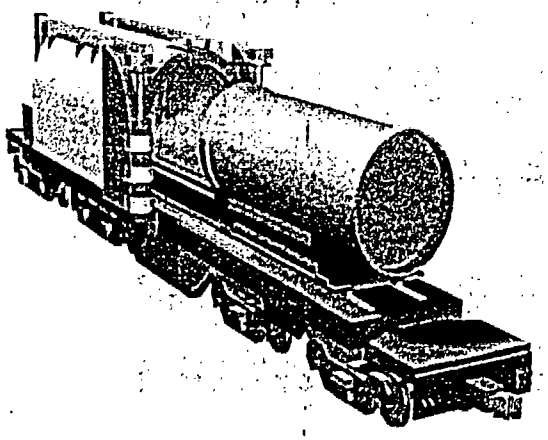
- **Ground support in emplacement drifts:**
  - Friction rock bolts
  - Bernold-type perforated sheets
  - Installed in a 240° arc around drift periphery
  - Stainless steel (316 or better)



Emplacement Drift Ground Support

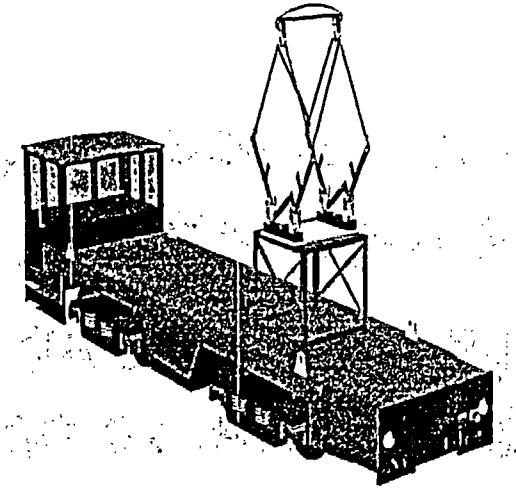
- Function - generally maintains drift configuration
  - Access for emplacement
  - Access for performance confirmation
  - Access for retrieval
  - Flowpath for preclosure ventilation
- Protection of waste package from design bases rockfall is not a function of ground support
- ITS SSCs
  - Waste package design
- Emplacement drift ground support not-ITS

Emplacement and Retrieval Equipment



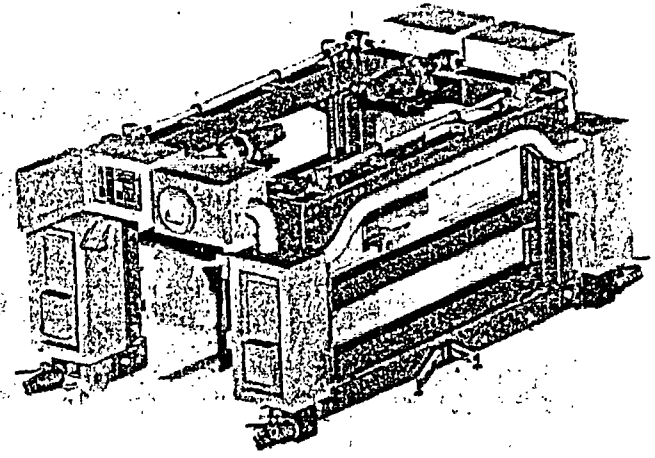
Waste Package Transporter

- Will transport individual waste package pallet assemblies from the surface facilities to the emplacement drift
- Shielded enclosure
- Remotely controlled from transport locomotive



Transport Locomotive

- Will provide propulsion for the waste package transporter, as well as other support equipment
- Remote and local control
- Prevents runaway



Emplacement Gantry

- Will move and emplace waste package pallet assemblies within emplacement drift
- Interlock for sequence

Loss of Control of Transporter on the North Ramp

- Waste packages are transported down the North Ramp to the subsurface during the preclosure time period
- Postulate a runaway initiated at the top of ramp by any cause
- Length and grade of ramp could result in speed of derailment and turnover speeds on first curve
- Safety strategy is prevention by providing features to reduce the likelihood of runaway to less than Category 2
- SSCs credited to meet this design basis are ITS

Loss of Control of Transporter on the North Ramp

(Continued)

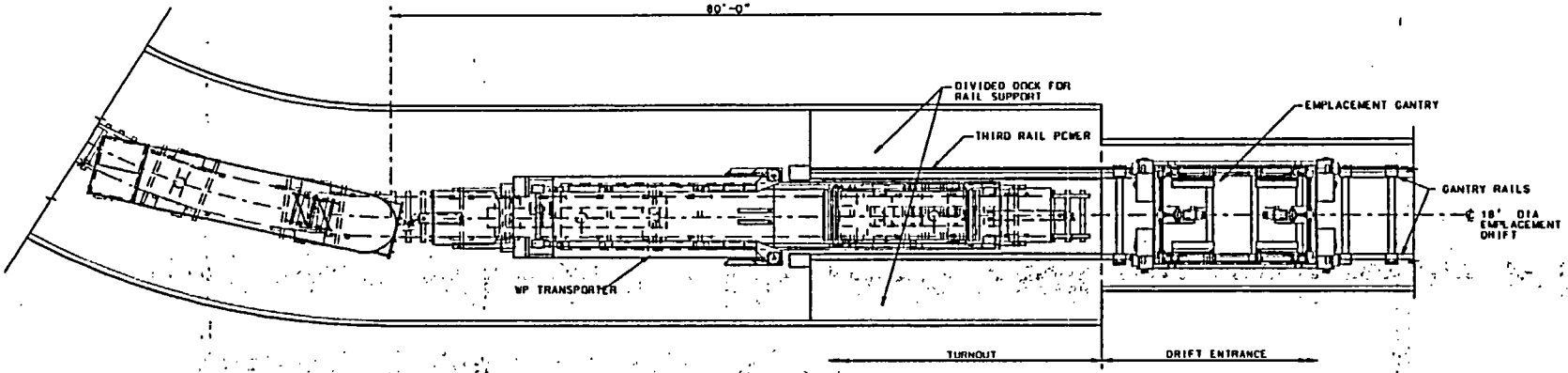
- Example subsystems and components of locomotive that become ITS
  - Airbrake system: reservoirs, airpipe, control valves, wheel-truck actuation cylinders, mechanical linkage, brake shoes
  - Regenerative brake system: traction motor, gear box, axles, resistor bank
  - Control system that actuates emergency brake on overspeed
  - Coupler (traction) and connectors to transporter
  - Gated vehicle crossings of the railway
  - Limit on speed of the surface transporter
- Any other subsystem or component not credited in event sequence analysis is not ITS

Loss of Control of Transporter on the North Ramp

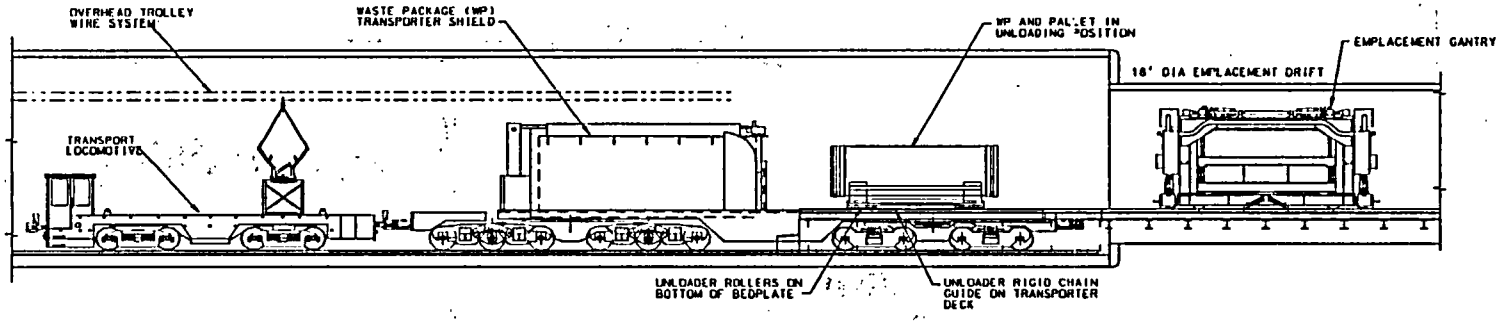
(Continued)

- Example subsystems and components of transporter car that become ITS
  - Airbrake system: reservoirs, airpipe, control valves, wheel-truck actuation cylinders, mechanical linkage, brake shoes
  - Coupler (traction) and connectors to transporter
  - Restraints to immobilize the bedplate
- Other transporter ITS function
  - Protects waste package from rockfall
  - Limits waste package drop heights

Emplacement Operations Near Loading Dock



PLAN OF TURNOUT & DRIFT
SCALE: 1/8"=1'-0"



ELEVATION OF TURNOUT & DRIFT
SCALE: 1/8"=1'-0"

Emplacement Operations
Near Loading Dock
(Continued)

- **Transporter**
  - Moved near loading dock
  - Shield doors opened
  - Moved to docking position, assisted by position indicators and TV monitors
  - Bed plate extended, with waste package resting on pallet

Emplacement Operations Near Loading Dock

(Continued)

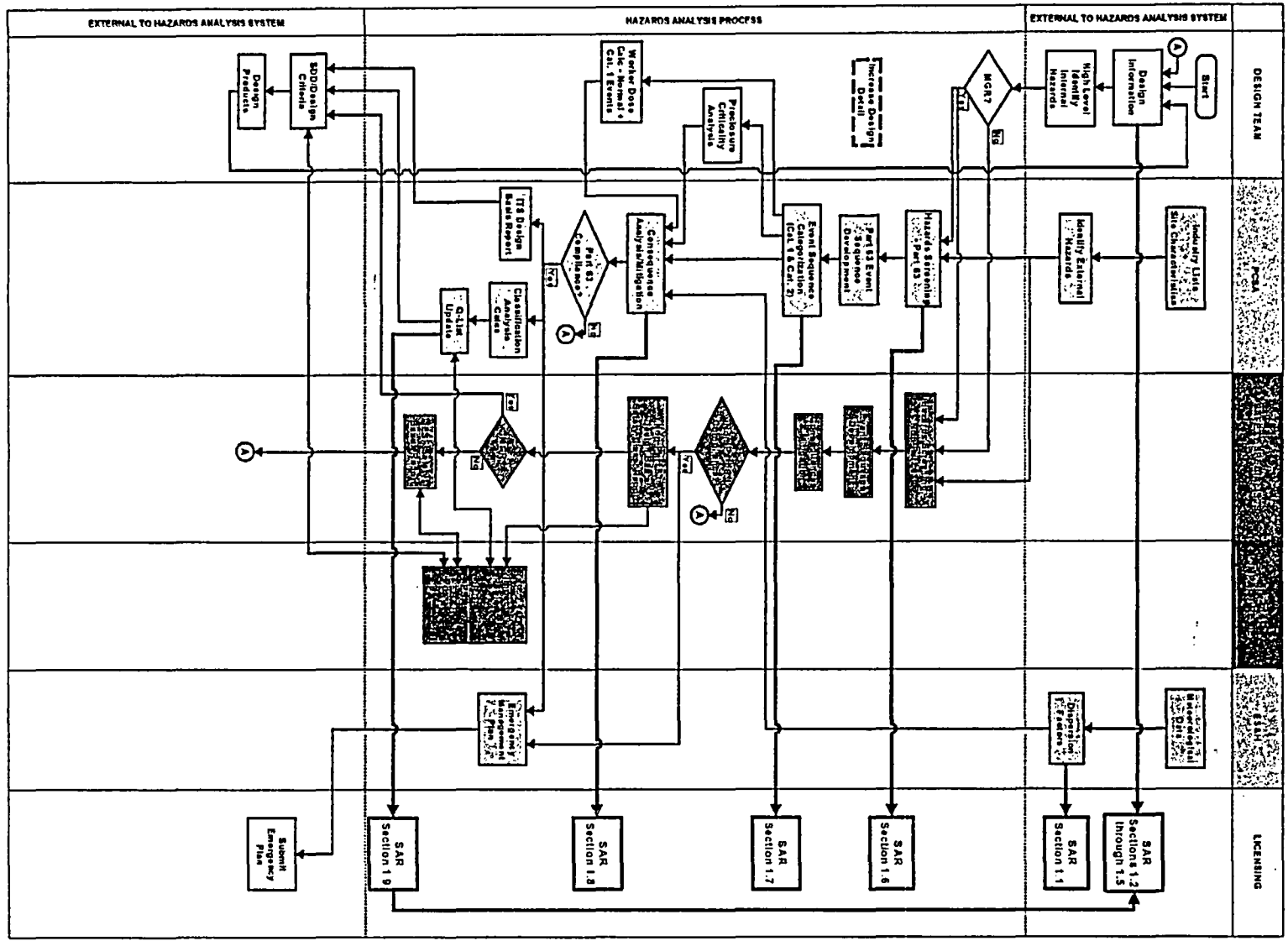
- **Emplacement gantry**
  - Moved out of emplacement drift to straddle the waste package and pallet
  - Lift mechanism lowered to engage the pallet and lift the pallet and waste package
  - Moved into emplacement drift carrying pallet and waste package to designated emplacement location
  - Lift mechanism lowered to release the pallet and waste package; gantry mechanism cannot release pallet unless it is resting
- **Interlocks provided to ensure proper sequencing of operations of transporter car and gantry**

Emplacement Operations Near Loading Dock
(Continued)

- Postulate a premature departure of transporter while loaded gantry remains at the transfer dock
- Initiating event is human-induced
- Potential drop of waste package exceeds design bases of waste package
- Safety strategy is prevention
- Event sequence rendered Beyond Category 2 by ITS SSC, such as interlock in control system

Documentation of Structures, Systems and Components Important to Safety in Safety Analysis Report

Hazards Analysis Process



Safety Analysis Report Outline
(Continued)

- **Ch 1 - Repository Safety Prior to Permanent Closure**
  - 1.1 Site Description
  - 1.2 Surface Structures, Systems, or Components (SSCs)
  - 1.3 Subsurface SSCs
  - 1.4 Infrastructure SSCs
  - 1.5 Waste Package

Safety Analysis Report Outline
(Continued)

- **Ch 1 - Repository Safety Prior to Permanent Closure**
  - 1.6 Identification of Hazards Analysis and Initiating Events
  - 1.7 Event Sequences
  - 1.8 Consequence Analysis
  - 1.9 SSCs Important to Safety
  - 1.10 As Low As Is Reasonably Achievable (ALARA)
  - 1.11 Plans for Retrieval and Alternate Storage of Waste
  - 1.12 Plans for Permanent Closure and Decontamination
  - 1.13 Equipment Qualification Program

Safety Analysis Report Outline

(Continued)

- **Outline of Surface SSC**
  - 1.2.x.y.1 SSC Description (F&OR, SDD, GA, P&ID) [2.1.1.2.2 RM1, RM2, 2.1.1.2.3 AC1, AC2]
  - 1.2.x.y.2 Operational Processes and Procedures (SDD, P&ID) [2.1.1.2.2 RM6, 2.1.1.2.3 AC6]
  - 1.2.x.y.3 Considerations Important to Safety (SDD, P&ID, PCSA) [2.1.1.6.2 RM1, 2.1.1.6.3 AC1]
  - 1.2.x.y.4 Administrative or Procedural Safety Controls to Prevent Event Sequences or Mitigate Their Effects (PCSA) [2.1.1.6.2 RM2, 2.1.1.6.3 AC2]
  - 1.2.x.y.5 Design Criteria and Design Bases (Project Design Criteria, SDD and PCSA) [2.1.1.7.2.1 RM1, 2.1.1.7.3.1 AC1]
- **X-facility (e.g. DTF) y-system (Source) [YMRP]**

Safety Analysis Report Outline
(Continued)

- **Outline of surface SSC** (Continued)
  - 1.2.x.y.6 Design Methodologies (SDD, Calculations) [2.1.1.7.2.2 RM1, 2.1.1.7.3.2 AC1]
  - 1.2.x.y.7 Consistency of Materials with Design Methodologies (SDD, P&ID and Calculations) [2.1.1.7.2.3 I RM2, 2.1.1.7.2.3 I AC2]
  - 1.2.x.y.8 Design Codes and Standards (PDC, SDD) [2.1.1.7.2.3 I RM1, 2.1.1.7.3.3 I AC1]
  - 1.2.x.y.9 Design Load Combinations (PDC, FDD, Calculations) [2.1.1.7.2.3 I RM3, 2.1.1.7.3.3 I AC3]
- **X-facility (e.g. DTF) y-system (Source) [YMRP]**

Examples of Classification and Nuclear Design Bases of Systems and Subsystems

System	Subsystem or Function	Important to Safety (ITS)	Safety Category (SC)	Nuclear Design Basis
Emplacement and Retrieval (continued)	Waste Package Loadout Preparation (continued)	Yes	SC	(j) The system must be designed so seismic events will not initiate a Category 1 or Category 2 event sequence. (k) Overhead bridge cranes must have a reliability such that the probability of a drop per transfer is less than or equal to 1.4×10^{-5}.
	Waste Package Transportation	Yes	SC	(a) Vehicle crossings of the railway used by a subsurface transporter carrying a waste package should be prevented or (if such crossings cannot be prevented), the crossings must be gated and alarmed. (b) The speed of the subsurface transporter and the emplacement gantry must not exceed 8 km/h. (c) The probability of a subsurface transporter runaway event sequence must be Beyond Category 2. (d) The shielding compartment of the subsurface transporter must withstand bounding credible rockfalls as well as the fall of failed ground support materials in the subsurface areas where the transporter carrying a waste package is expected to travel. (e) The restraints used to immobilize the bedplate inside the shielding compartment of the transporter and the mechanism for locking the shielding compartment's doors must withstand a credible collision or derailment of the transporter without failure. (f) Spurious or operator-included opening of the subsurface transporter shielding compartment doors, followed by actuation of the bedplate rollout mechanism, must be precluded when the transporter is in motion. (g) The system must be designed so seismic events will not initiate a Category 1 or Category 2 event sequence.